

WHAT IS CLAIMED IS:

1. A control device for a hybrid vehicle, the hybrid vehicle including a motor, connected to an engine output shaft, to which an engine output is transmitted, and an automatic transmission, the automatic transmission including an input shaft, connected to the engine output shaft, and an output shaft, connected to a driving wheel, the control device comprising:

a request output detection unit that detects a driver's requested output;

an engine control unit that controls the engine output;

a motor control unit that controls motor output so that total output of the motor output and the engine output becomes the driver's requested output; and

a limitation request output unit that, when the driver's requested output is larger than input-available driving force to the input shaft of the automatic transmission, outputs a limitation request to limit the total output to a limitation output, which is smaller than or equal to the input-available driving force, wherein the motor control unit, when the limitation request is output by the limitation request output unit, controls the motor output so that the total output of the motor output and the engine output becomes the limitation output.

2. The control device for the hybrid vehicle of the claim 1, wherein the engine control unit controls the engine output so that the engine achieves a best fuel efficiency condition based on an engine rotation number.

3. The control device for the hybrid vehicle of the claim 2, wherein the control device further comprises an output difference detection unit that detects a difference between the engine output and the limitation output, wherein the motor control unit, when the limitation request is output by the limitation request output unit and the engine output is larger than the limitation output, controls the motor in a regeneration state on the basis of the difference between the engine output and the limitation output, detected by the output difference detection unit.

4. The control device for the hybrid vehicle of the claim 3, wherein the motor control unit, when the limitation request is output by the limitation request output unit and the engine output is smaller than the limitation output, controls the motor in a powering state so that the total output of the motor output and the engine output becomes the limitation output.

5. The control device for the hybrid vehicle of the claim 4, wherein the control device further comprises motor capacity detection unit that detects a driving force, which can be output by the motor, wherein the engine control unit, when the total output does not become the limitation output by the driving force, which can be output by the motor, detected

by the motor capacity detection unit, controls the engine output so that the total output becomes the limitation output.

6. The control device for the hybrid vehicle of the claim 5, wherein the motor includes a stator and a rotor, the rotor directly connected to the engine output shaft.

7. The control device for the hybrid vehicle of the claim 5, wherein the automatic transmission includes a multiple-step transmission mechanism, which changes rotation of the input shaft into multiple gear speeds and outputs the gear speeds to the output shaft.

8. The control device for the hybrid vehicle of the claim 1, wherein the control device further comprises an output difference detection unit that detects a difference between the engine output and the limitation output, wherein the motor control unit, when the limitation request is output by the limitation request output unit and the engine output is larger than the limitation output, controls the motor in a regeneration state on the basis of the difference between the engine output and the limitation output, detected by the output difference detection unit.

9. The control device for the hybrid vehicle of the claim 8, wherein the motor control unit, when the limitation request is output by the limitation request output unit and the engine output is smaller than the limitation output, controls the motor in a powering state so that the total output of the motor output and the engine output becomes the limitation output.

10. The control device for the hybrid vehicle of the claim 9, wherein the control device further comprises motor capacity detection unit that detects a driving force, which can be output by the motor, wherein the engine control unit, when the total output does not become the limitation output by the driving force, which can be output by the motor, detected by the motor capacity detection unit, controls the engine output so that the total output becomes the limitation output.

11. The control device for the hybrid vehicle of the claim 1, wherein the motor control unit, when the limitation request is output by the limitation request output unit and the engine output is smaller than the limitation output, controls the motor in a powering state so that the total output of the motor output and the engine output becomes the limitation output.

12. The control device for the hybrid vehicle of the claim 1, wherein the control device further comprises motor capacity detection unit that detects a driving force, which can be output by the motor, wherein the engine control unit, when the total output does not become the limitation output by the driving force, which can be output by the motor, detected

by the motor capacity detection unit, controls the engine output so that the total output becomes the limitation output.

13. A method for controlling a hybrid vehicle, the hybrid vehicle including a motor connected to an engine output shaft, to which an engine output is transmitted, and an automatic transmission, the automatic transmission including an input shaft connected to the engine output shaft, and an output shaft connected to a driving wheel, the method comprising:

identifying a request torque of an operator and a limitation torque of the automatic transmission;

determining an engine torque produced when the engine operates at a predetermined best torque based on engine speed;

calculating a difference between a lower torque of the request torque and the limitation torque and the predetermined best torque;

controlling a motor to provide additional torque when the best torque is less than the lower torque and a regeneration torque when the lower torque is greater than the best torque; and

adjusting the engine torque when a combination of best torque and the one of a maximum additional torque and a maximum regeneration torque of the motor can't provide the lower torque.

14. The method according to claim 13, wherein the adjusting step is accomplished by delaying ignition timing of the engine when the maximum regeneration torque of the motor cannot lower the best torque to obtain the lower torque.

15. The method according to claim 13, wherein the adjusting step is accomplished by increasing engine torque beyond the best torque when a sum of the best torque and the maximum motor torque are less than the lower torque.

16. A control method for a hybrid vehicle, the hybrid vehicle including a motor, connected to an engine output shaft, to which an engine output is transmitted, and an automatic transmission, the automatic transmission including an input shaft, connected to the engine output shaft, and an output shaft, connected to a driving wheel, the method comprising:

detecting a driver's requested output;

controlling the engine output;

controlling motor output so that a total output of the motor output and the engine output becomes the driver's requested output; and

when the driver's requested output is larger than input-available driving force to the input shaft of the automatic transmission, limiting the total output to a limitation output, which is smaller than or equal to the input-available driving force, wherein, when the total output is limited to the limitation output, controlling the motor output so that the total output of the motor output and the engine output becomes the limitation output.

17. The control method for the hybrid vehicle of the claim 16, wherein controlling the engine output achieves a best fuel efficiency condition of the engine based on an engine rotation number.

18. The control method for the hybrid vehicle of the claim 16, further comprising detecting a difference between the engine output and the limitation output, wherein, when the engine output is larger than the limitation output, the motor is controlled in a regeneration state on the basis of the difference between the engine output and the limitation output.

19. The control method for the hybrid vehicle of the claim 16, wherein, when the engine output is smaller than the limitation output, the motor is controlled in a powering state so that the total output of the motor output and the engine output becomes the limitation output.

20. The control method for the hybrid vehicle of the claim 16, further comprising detecting a driving force which can be output by the motor, wherein when the total output does not become the limitation output using the motor output, further controlling the engine output so that the total output becomes the limitation output.

21. A control device for a hybrid vehicle, the hybrid vehicle including a motor, connected to an engine output shaft, to which an engine output is transmitted, and an automatic transmission, the automatic transmission including an input shaft, connected to the engine output shaft, and an output shaft, connected to a driving wheel, the control device comprising:

request output detection means for detecting a driver's requested output;
engine control means for controlling the engine output;
motor control means for controlling motor output so that total output of the motor output and the engine output becomes the driver's requested output; and

limitation request output means for, when the driver's requested output is larger than an input-available driving force to the input shaft of the automatic transmission, outputting a limitation request to limit the total output to limitation output, which is smaller than or equal to the input-available driving force, wherein the motor control means, when the limitation request is output by the limitation request output means, controls the motor output

so that the total output of the motor output and the engine output becomes the limitation output.

22. The control device for the hybrid vehicle of the claim 21, wherein the engine control means controls the engine output so that the engine achieves a best fuel efficiency condition based on an engine rotation number.

23. The control device for the hybrid vehicle of the claim 21, wherein the control device further comprises output difference detection means for detecting a difference between the engine output and the limitation output, wherein the motor control means, when the limitation request is output by the limitation request output means and the engine output is larger than the limitation output, controls the motor in a regeneration state on the basis of the difference between the engine output and the limitation output, detected by the output difference detection means.

24. The control device for the hybrid vehicle of the claim 21, wherein the motor control means, when the limitation request is output by the limitation request output means and the engine output is smaller than the limitation output, controls the motor in a powering state so that the total output of the motor output and the engine output becomes the limitation output.

25. The control device for the hybrid vehicle of the claim 21, wherein the control device further comprises motor capacity detection means that detects a driving force, which can be output by the motor, wherein the engine control means, when the total output does not become the limitation output by the driving force, which can be output by the motor, detected by the motor capacity detection means, controls the engine output so that the total output becomes the limitation output.